
Quarterly Progress Report #4

For the project entitled:

Field Evaluation of the Performance of Three Concrete Bridge Decks on Montana Route 243

*Reporting Period: October 1, 2002 – December 31, 2002
(Quarter 2, State Fiscal Year 2003)*

Summary of Expenditures

The table below summarizes the expenditures on this project through December 31, 2002. Expenditures during this quarter were \$30,158.69, with total expenditures through December 31, 2002 equaling \$100,191.47.

Budget Category	Spent through 9/30/02	Spent This Quarter	Total Spent
Salaries	\$24,282.46	\$8,432.39	\$32,714.85
Benefits	\$3,452.09	\$1,264.63	\$4,716.72
In-State Travel	\$393.25	\$0.00	\$393.25
Expendable Supplies	\$1,460.14	\$82.35	\$1,542.49
Tuition	\$4,214.25	\$10,541.00	\$14,755.25
Reporting	\$0.00	\$0.00	\$0.00
MDT Direct Costs	\$33,802.19	\$20,320.37	\$54,122.56
Overhead	\$5,917.63	\$1,955.90	\$7,873.53
MDT Share	\$39,719.82	\$22,276.27	\$61,996.09
WTI Share (Equipment and Out-of-State Travel)	\$30,312.96	\$7,882.42	\$38,195.38
Total	\$70,032.78	\$30,158.69	\$100,191.47

Task A: Project Management

Sletten Construction was contacted to obtain their construction schedule. The research schedule was integrated into Sletten's schedule to minimize delays associated with the research during construction. Due to delays of the construction start date, the research schedule has shifted forward by approximately six months. This affect will most likely shift the end date of the project by the same amount. This change will be evaluated later and an updated schedule will be presented to the Montana Department of Transportation for review. Subsequently, project spending by fiscal years has also shifted. As such, an updated spending schedule was delivered to Sue Sillick detailing changes to monetary allocations by state and federal fiscal years.

Action Items for Next Quarter:

- Prepare for pre-decking meeting in Saco, Montana

Task B: Conduct Literature Review

The primary literature review for this project has been completed. Nonetheless, the time frame for this project is quite long, so information will continue to be collected throughout its duration.

Action Items for next quarter:

- Continue collecting relevant literature
- Write up the literature review for use in future documentation and in the instrumentation plan

Task C: Develop Instrumentation Plan and Assemble Data Acquisition System**Determine Gage Locations**

Work continued on documenting the process used to select the gage locations in each deck. A very rough draft of a report on this work was completed. The already completed instrumentation lists and layouts for each deck will be augmented with descriptions of the installation procedures to be used for each type of gage. This information will be compiled along with a description of the process by which the instrumentation locations were selected. This draft should be finalized and its contents made available to MDT next quarter.

Action Items for Next Quarter:

- Finalize and send draft instrumentation plan to MDT

Purchase and Assemble Weather Station

An Internet website to organize and disseminate real-time weather data was finalized. Its features include:

- ♦ 15 minute updates of temperature, wind speed and direction, relative humidity, dew point, and barometric pressure;
- ♦ a collection of the past 24 hours of data updated every 15 minutes;
- ♦ 1 month of daily averages;
- ♦ 1 month of daily maximums;
- ♦ 1 month of daily minimums; and
- ♦ various pictures associated with the project.

The Internet link to view current weather conditions at Saco, Montana is

http://wtigis.coe.montana.edu/saco/Saco_Current.htm. Links to the other information previously outlined can be made from this page. A database is being developed to store and organize data collected from the weather station.

Action Items for Next Quarter:

- Finalize database to organize and store weather data

Purchase and Assemble Bridge Monitoring Data Acquisition System

Work this quarter has focused on purchasing strain gage equipment, finalizing and testing the procedure for installing the bonded strain gages, building an instrumented concrete test beam, fabricating and refining the prototype circuitry used in conjunction with the bonded strain gages, and programming the data logger.

Hardware and equipment necessary to install the bonded foil strain gages was purchased. This included gages, glues, environmental coatings, wire, and resistors. In the coming quarter, the remaining sensors and data acquisition components will be purchased and tested. The remaining items include the vibrating wire strain sensors, embedded strain gages, solar panels, and data transfer equipment.

The specific procedure to be used to install the bonded strain gages on the reinforcing steel was finalized. Two epoxy coated bars were subsequently instrumented with strain gages and tested in uniaxial tension in the laboratory. These tests were conducted to a) insure that gage installations performed as expected, and b) investigate some options regarding the electrical circuitry used with the gages.

The majority of the work this quarter has focused on fabricating and refining the prototype circuitry used. This circuitry provides an electronic link between the bonded gages and the data acquisition system. The two main items of concern regarding the circuitry are 1) the presence of electrical noise and 2) differences between single-ended and differential inputs to the data acquisition system. Ambient noise can come from a variety of sources. Detecting and adequately reducing signal noise is important so that greater strain measurement precision can be achieved. A concrete test beam provided the opportunity to both detect and reduce signal noise by mechanical, computer and electronic means.

A concrete test beam (.25 m deep by .15 m wide by 1.52 m long) was fabricated using epoxy-coated rebar instrumented with the strain gages to test the prototype circuitry. Other reasons for building this test beam were to investigate 1) gage sensitivity to the concrete vibrator, 2) cabling issues, and 3) durability of the gages under loading. To realize the first of these objectives, the gages at one location in the beam were purposefully abused during the construction process. All of the gages survived construction intact, indicating that the environmental protection being used on the gages was adequate in the short term.

Due to the large number of sensors, special circuitry was created to convert differential analog outputs (a two-wire system) to a single analog output (a one-wire system). This essentially doubled the capacity of the data acquisition system, thereby allowing more sensors to be simultaneously monitored. Both types of circuits (differential and single-ended) were built and tested to verify that their outputs were comparable.

An initial computer program was written using the software provided by Campbell Scientific for the data acquisition system. This program is a model of the final program that will be used by the data acquisition system during the live load testing. The computer program and circuitry will be further tested next quarter by applying various loads to the test beam. Results from the beam test will be used to modify the circuitry and program if necessary.

Action Items for Next Quarter:

- Test reinforced concrete beam
- Test current circuitry and build final circuitry
- Test current program and write final program
- Order remaining sensors and data acquisition components

Task D: Install Instrumentation and Compile As-Built Documentation

Reinforcing bars scheduled for use during construction of the bridge decks were ordered directly from the manufacturer and shipped to the campus at Montana State University to allow the bonded strain gages to be installed under more controlled conditions. The reinforcing steel was purchased by Sletten. Shipping costs to MSU, and later to the construction site, will be paid by MSU. The finished bars will be stored on the MSU campus until they are needed at the construction site.

Action Items for Next Quarter

- Begin installation of the bonded strain gages on the reinforcing steel

Task H: Project Reporting

A draft instrumentation plan has been prepared which includes a) a summary of the process used to select the proposed instrumentation locations, b) a complete instrumentation list that indicates the type, location, and expected level of response of each gage, and c) a thorough description of the specific installation method proposed for each type of gage including the manner in which it will be wired into the data acquisition system.

Action Items for Next Quarter:

- Quarterly progress report for third quarter for state fiscal year 2003